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ABSTRACT

Using agency theory, this paper analyzes schools, particularly career schools, in the Stafford Loan Program for student incentive to graduate and pay off their loans. Agency theory focuses on the roles of information and incentives when a principal and an agent cooperate with respect to the utilization of resources. The analysis examines the incentives provided by the principal, the Federal Government, for its agent, the career school. The financial structure of a school and the current financial aid program are modeled and show that the student loan programs can cost approximately $120,000 per 100-student school annually. This analysis also shows that the current system encourages schools not to be selective, not to exert any special recruitment effort, and to increase their capacity to enroll large numbers of students they believe are unqualified. An alternative structure is shown using agency theory and introducing parameter values that maximize both the agent's and principal's interests. This system would reward schools for selection effort and minimize costs to the government. A numerical example of the alternative structure applied to a hypothetical school is included. Also included are 13 references and 1 table. (JB)

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Agency Theory, Incentives, and Student Loans

Lawrence M. Rudner[*]

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Agency Theory, Incentives, and Student Loans

Abstract

Agency theory focuses on the roles of information and incentives when a principal and an agent cooperate with respect to the utilization of resources. This article shows that schools in the Stafford Loan Program currently do not have an incentive to enroll students who can be expected to graduate and pay-off their student loans. Using agency theory an alternative structure is proposed which provided the appropriate incentive.

Agency Theory, Incentives, and Student Loans

While the Stafford Student Loan Program[1] serves over 4.7 million students in 7,500 post-secondary programs annually, the growing costs and liability of this program cause a great deal of alarm and serious questioning. The federal cost of this loan program has grown to nearly $4.5 billion annually with a current liability of over $45.1 billion in outstanding debt. The magnitude of the Stafford Program places it among the five riskiest programs managed by the U.S. Government (Donlon, 1990).

Part of the program risk is due to career school students. When the program was first established, the majority of loans went to middle class students attending 4 year colleges. With the recent large increase in public school dropouts (500,000 in 1985; 1,000,000 in 1990; National Center for Educational Statistics, 1991), many high risk students have turned to career schools to obtain a skill. While career schools try to provide these students with an education, many drop out and don't pay off their loans. Since the loans are guaranteed, the entire risk burden rests with the federal government.

The government would like to see loans going to students that will graduate, get good jobs, and pay off their loans. If schools would recruit more students and be

[1] formerly called the Guaranteed Student Loan Program

more selective, more students would graduate and the cost of the program to the government would diminish greatly. Additional recruitment and selection is not, however, in the school's interest. Schools do not receive extra revenue to offset recruitment and selection costs. The obvious solution of rewarding recruitment and selection isn't practical. The government cannot easily obtain accurate data on the recruitment and selection efforts of 4,000 career schools. Nevertheless, the government needs to induce the schools to behave in a manner that is consistent with the government's desires.

Microeconomic and corporate finance researchers will immediately recognize this as a classic agency theory problem. As described by Bamberg and Spremann (1987), agency theory focuses on the roles of information and incentives when a principal and an agent cooperate with respect to the utilization of resources. The agent, in this case the school owner, makes decisions which affect his own welfare and that of the principal, in this case the federal government. Modifications of the agent's actions which are preferred by the principal yield disutilities to the agent. Asymmetric information precludes simple arrangements where the agent's modified actions are rewarded directly.

Classic applications of agency theory can be found in Ross (1973), Stiglitz (1974), and Holmstrom (1982). Applications in a variety of settings are abundant. Spence and Zeckhauser (1971) investigated agency theory in the content of insurance contracts. Basu, Srinivasan and Staelin (1985) examined sales force compensation.

Most recently John, John, and Senbet (1991) addressed the Federal Deposit Insurance reform using agency theory. Excellent textbooks on the topic have been prepared by Barnea, Haugen and Senbet (1985) and Bamberg and Spremann (1987).

In this paper, the incentives provided by the principal, the federal government, for its agent, the career school, are examined. With industry averages and a few simplifying assumptions, I show that current design of the student loan program can cost approximately $120,000 per 100 student school annually. An alternative funding system is proposed which can reduce this figure to $85,000 per school.

This paper is organized as follows. First, the financial structure of a school and the current financial aid program are modeled. The analysis leads to the conclusion that schools involved in the financial aid program do not have an incentive to selectively admit students or recruit beyond their capacity. Second, an alternative structure is introduced and parameter values that maximize both the agent's and principal's interests are identified. Finally, a few fiscal implications are discussed.

Model

To develop a model that reflects the current situation, we start with a classical financial paradigm and initially assume the school can enroll as many students as it

desires. From this, we determine the optimal capacity under the current structure and evaluate the school's incentive to recruit and be selective. The amount of money wasted by the current payment plan is also identified. Let:

x	subscript agent effort. Agent effort can be exerted by being more selective or by recruiting more applicants.
n_r	be the number of recruits. The number of recruits is the sum of the number of people that apply on their own (walk-ins), n_k, and an increment, n_x, due to extra recruitment effort.
p_q	be the proportion of students in the service population that have the ability to benefit from the program, i.e. the proportion of students that are qualified, $0 \leq p_q \leq 1$.
p_s	be the proportion of all applicants selected to be enrolled in the program, $0 \leq p_s \leq 1$.

The number of students enrolled, n_e, is then

$$n_e = p_s (n_k + n_x) \tag{1}$$

Schools seek to generate revenues in excess of fixed and variable expenses. Since schools receive tuition for all enrolled students, the school's wealth is

$$w = Tn_e - F - V \tag{2}$$

where T is the tuition paid for each student

F is the fixed costs

V are variable costs.

Variable costs are a function of the number of enrolled students, the per enrolled student expense, E, and the convex increasing recruitment costs per student, Rn_x. Thus,

$$V = n_e E + Rn_x^2 \tag{3}$$

Theorem 1: Without a capacity limit, the profit maximizing school will accept all applicants.

From (1), (2), and (3), wealth is

$$w = (T-E)\, p_s\, (n_k + n_x) - Rn_x^2 - F \tag{4}$$

The agent's action is predicted by maximizing w in (4) with respect to p_s. Since $\delta w/\delta p_s$ is a constant, wealth is maximized when p_s is at its largest possible value, i.e. $p_s = 1$. The school has no incentive to be selective.

Corollary: Without a capacity limit, the profit maximizing agent will recruit (T-E)/2R students.

The agent's action is predicted by setting $p_s = 1$ and maximizing w in (4) with respect to n_r.

With $p_s=1$, $1-p_q$ of these students will be unqualified. The current fiscal structure encourages schools to exert recruitment effort which results in $(1-p_q)n_rT$ wasted tuition dollars in addition to the $(1-p_q)n_kT$ dollars that would be wasted had there not been any recruiting. The fiscal structure encourages schools to exacerbate the very problem the principal wishes to minimize.

Because this structure has been in existence for over 15 years, we can expect the profit maximizing school to have expanded its capacity so it can enroll the profit maximizing number of students, $n_k + (T-E)/2R$. We will denote this capacity level as N_k and treat the costs associated with the corresponding base level recruitment effort as part of the fixed costs, F. The term n_r shall refer to recruitment in excess of the current capacity, N_k.

Theorem 2: With a capacity limit, N_k, on enrollment, the school does not have any incentive to recruit or be selective, i.e. $n_r=0$, and $p_s=1$.

From (4)

$$w = (T-E)\max[p_s(N_k+n_r), N_k] - Rn_r^2 - F \qquad (5)$$

The $\delta w/\delta p_s$ is still a constant and wealth is again maximized at the maximum value of $p_s = 1$. With $p_s = 1$, the school fills its capacity with the N_k available students. Additional recruitment costs Rn_x dollars per student while not contributing to the school's wealth. Thus, $n_e = N_k$.

An alternative incentive system

The preceding section shows that the current system has several major drawbacks. Schools are encouraged not to be selective, not to exert any special recruitment effort, and to increase their capacity to enroll large numbers of students they believe, a priori, are unqualified. As a result, government backed loans are going to a large number of students who the agent suspects are unqualified, will probably not graduate, and will probably not pay-off the loan.

The task, then, is to develop a payment system that rewards schools for selection effort and minimizes costs to the government. While the government cannot directly observe selection effort, it can observe and maximize a result of selection effort -- the number of successful students[1]. Using this information and knowledge of the school's fiscal desires, an incentive system is developed that

[1] A successful student is defined as one who is employed in the field within some set number of months after graduation. We don't want to maximize just the number of graduates as this creates an incentive for schools to lower their graduation requirements. We make the simplifying assumption that all successful students pay off their loans and that all drop-outs default.

encourages the school to behave in a manner that is more consistent with the government's desires.

Let the payment structure be $T_1 N_k + I n_s$, a payment for each enrolled student plus an incentive for each successful student, n_s. Values for T_1 and I that are optimal from the government's perspective will be identified.

Under this structure, the number of successful students, n_s, is the product of the a) school capacity, N_k, and b) the sum of proportion of successful students that would enroll without effort, $p_{s|0}$ and effort, p_x. The school's terminal wealth, then, is

$$w = T_1 N_k - F + I(p_{s|0} + p_x)N_k - Rn_x^2 \quad (6)$$

Variable costs incurred in recruiting the N_k students have been subsumed in F. If the school becomes selective, it must go out and recruit students to fill the seats left vacant. As a result, $n_x = p_x N_k/(1-p_x)$. Thus, (6) can be approximated by

$$w = T_1 N_k - F + I(p_{s|0} + p_x)N_k - cp_x^2 \quad (7)$$

where $c = R N_k^2$.

Note that (6) and (7) are more general cases of (5). If the new base tuition is the same as the old tuition and no incentive is provided, i.e. $T_1 = T_0$ and $I = 0$, then wealth is again maximized at $n_x = 0$ and $p_x = 0$.

Question 1: Given the payment plan outlined in (7), what effort will be exerted by the school?

The school will choose the level of effort that maximizes his terminal wealth. The profit maximizing response to (7) is:

$$p_x^* = \frac{IN_k}{2c} \tag{8}$$

From (8) note that effort will increase as

a) the fiscal incentive, I, increases

b) the size of the school, N_k, increases

c) the cost factor, c, decreases.

The guaranteed tuition given for each enrollee, T_1, does not affect the effort exerted by the school. It does, however, have a major affect on the school's wealth. If it is set low, the government will save money, but schools will be driven out of business. If it is set high, it will cost the government needlessly. The next task is to identify a payment schedule that maximizes the government's interest and at the same time holds harmless schools with a current, pre-specified graduation rate.

Question 2: What payment schedule $\{T_1, I\}$ will provide schools that already have a success rate of p_0 with at least T_0N_k dollars?

That is, if $p_{s|0} > p_0$, the government will guarantee that the school would receive as much revenue as before, i.e. T_0N_k dollars. Thus,

$$T_1N_k + IN_kp_0 > T_0N_k$$

$$T_1 > T_0 - Ip_0 \qquad (9)$$

Equation (9) provides a set of payment schedules that holds harmless schools with a success rate of at least p_0. The optimal values of I, T_1, and p_0 from the government's viewpoint are found next.

The government has two objectives:

1) maximize the number of successful students

2) minimize the size of the program.

Let b be the dollar value the government places on having a successful career school student. The government's objective function then is:

$$\text{Maximize } V = b\,(p_{s|0} + p_x)\,N_k - [T_1\,N_k + (p_{s|0} + p_x)\,I\,N_k]$$

$$= \quad b\,(p_{s|0} + p_x) \; - [\, T_1 + (p_{s|0} + p_x)I \,] \tag{10}$$

If the government is solely interested in minimizing the size of the program, b would be set to 0. On the other hand, if the government places a high value on producing successful students, b would be set to a very large number.

Question 3: Given the hold harmless constraint, what values of T_0 and I will maximize the government's objective function?

Substituting p_x^* and T_1 from (8) and (9) into (10) and optimizing with respect to I yields the objective maximizing incentive:

$$I^* = \frac{b}{2} + \frac{c}{N_k} \max(p_0 - p_{s|0}, 0) \tag{11}$$

The optimal value of the incentive increases as a function of the importance of successful students to the government. From the agent's point of view, I^* must be large enough to make recruiting worthwhile.

Substituting I^* into (11) yields the optimal value for T_1.

$$T_1^* = T_0 - \frac{bp_0}{2} - \frac{cp_{s|0}}{N_k} \max(p_0 - p_{s|0}, 0) \tag{12}$$

Equation (9) can now simplified

$$p_x^* = \frac{I^* N_k}{2c} = \frac{bN_k}{4c} + \frac{\max(p_0 - p_{s|0}, 0)}{2}$$

If the government values having successful graduates ($b > 0$) or if the hold-harmless success rate is higher than the current success rate, the school will exert recruitment effort. Once I^* has been announced, the school will increase its effort to at least half of the difference between the hold-harmless and current graduation rates.

From public information concerning the school -- capacity, recruitment cost, and current success rate -- a payment schedule can be identified that maximizes the government's objectives and at the same time assures protection for quality programs. The payment schedule $\{T_1^*, I^*\}$ defined by (11) and (12) induces the school to increase its effort from 0 to p_x^*.

A numerical example

The typical career school enrolls approximately 100 students per year, has a graduation rate of 65%, charges a tuition of \$3,500, and has a recruitment coefficient of \$10/student. Thus,

N_k	= 100	T_o	= \$3,500	R	= 10
$p_{s\|0}$	= .65	c	= $R N_k^2$ = 100,000		

To complete the input data needed for the model, the hold-harmless graduation rate (p_0) was set to .75 and three different valuations for a successful graduate (b)

were considered. Optimal values for the base tuition and the incentive were computed using (11) and (12). The results are shown in Table 1.

Under the simplifying assumption that all successful graduates pay off their loan and all unsuccessful students default, the current program can be expected to cost the federal government $122,500 per typical school.

If the sole objective is to keep the program small, b is set to 0. From the last column in Table 1, we can see that this results in the least amount of agent effort and smallest revenue to the school. Even at this valuation, the total cost to the government is down by 11%.

Placing a modest $500 value for a successful graduate results in a slightly larger program size. The optimal incentive value increases to $350. This in turn induces the school to recruit and be more selective. As a result, more students graduate and the default costs are reduced dramatically. Total program costs to the government drop 30%, from $122,500 to $85,531. A thirty percent cost reduction in the Stafford Loan Program would save the taxpayers over $600 million annually.

Table 1

Cost to the Government and School Income under Different Student Loan Program Financial Structures

	Current	---- Incentive ----		
Inputs				
Value of a graduate (b)	-	500	250	0
hold harmless value (p_0)	-	.75	.75	.75
Old graduation rate ($p_{s|0}$)	.65	.65	.65	.65
Tuition (T^*)	3,500	3,238	3,331	3,425
Incentive (I^*)	-	350	225	100
Outputs				
Induced effort (n_x^*)	0	.18	.11	.05
Graduation rate ($p_{s|0}+x^*$)	.65	.83	.76	.70
Costs to the government				
Default Cost	122,500	56,656	79,117	102,750
Incentive Cost	0	28,875	17,156	7,000
Total	122,500	85,531	96,273	109,750
School Income				
Tuition	350,000	323,750	333,125	342,500
Incentive	0	28,875	17,156	7,000
Total Revenue	350,000	352,625	350,281	349,500
Recruitment Costs	0	1,837	759	150
Total Income	350,000	350,788	349,522	349,350

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